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Electro Scientific Industries

13900 N.W. SCIENCE PARK DRIVE • PORTLAND, OREGON 97229

BRIDGES AND ACCESSORIES

SEPTEMBER 1966
REPLACES MARCH 1965

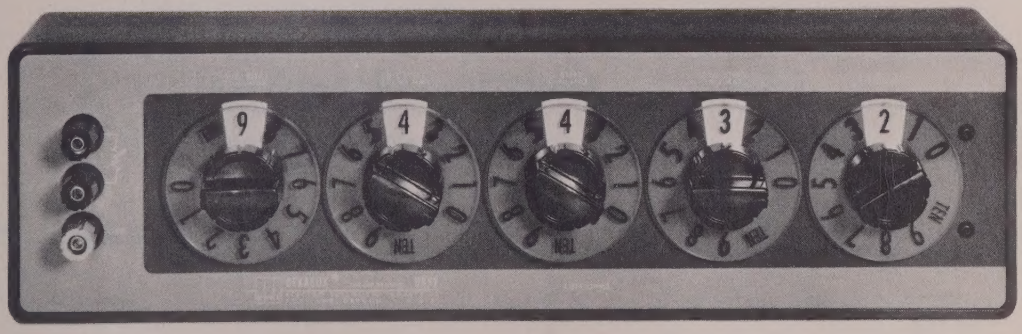
MODELS

DB 42
DB 52 DB 62

Instruction Manual

IN-LINE DEKABOX®

DECADE RESISTORS



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PORTAMETRIC® Portable Measuring Instrument
PVB® Potentiometric Voltmeter Bridge

I INTRODUCTION

1.1 Purpose of Equipment

The in-line DEKABOX® decade resistors are adjustable resistors that can be easily set to a resistance value for precision dc and audio frequency use.

1.2 Description

There are three models of Dekabox, Model DB 42 has four resistance decades, Model DB 52 has five, and Model DB 62 has six. Each unit consists of a metal case, three binding posts, and four, five, or six decade resistance switch assemblies. Figure 1-1 shows panel arrangement and dimensions of all models.

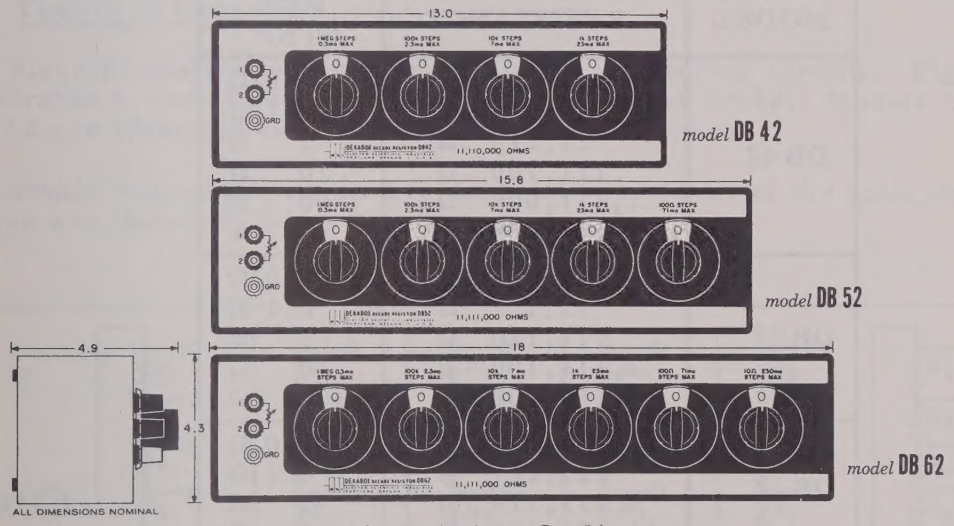

Figure 1-1 Dekabox Outlines

1.3 Specifications

INITIAL ACCURACY OF RESISTANCE CHANGE FROM ZERO SETTING:
±(0.01% + 0.0005 ohm per decade) at 23°C
LONG-TERM STABILITY: ±(0.01% + 0.001 ohm per decade) per year
APPROXIMATE ZERO RESISTANCE: 0.002 ohms per decade
RATING PER RESISTOR: See Table 1-1.
TEMPERATURE COEFFICIENT: See Table 1-1.
POWER COEFFICIENT: See Table 1-1.
NUMBER OF DECADES: DB42, four; DB52, five; DB62, six
BREAKDOWN VOLTAGE: See Table 1-1
WEIGHT: DB42, DB52, DB62 -- 4 lbs net. 10 lbs packed for shipping
MAXIMUM CURRENT PER RESISTOR: See Table 1-1

RESISTANCE PER DECADE (Ω)	RESISTANCE VALUE R* (Ω)	ACCURACY		COEFFICIENTS		MEASUREMENT DUTY MAXIMUM RATINGS		PEAK VOLTAGE (V/step)
		INITIAL (%)	LONG-TERM (%)	TEMPERATURE (ppm/°C)	POWER (ppm/mW/step)	POWER (mW/step)	CURRENT (mA)	
10 M	1 M	0.01	0.02	5	0.15	100	0.3	300
1 M	100 k	0.01	0.02	5	0.15	1000	3.2	300
100 k	10 k	0.01	0.02	5	0.15	1000	10	1500
10 k	1 k	0.01	0.02	5	0.15	1000	32	1500
1 k	100	0.01	0.02	5	0.15	1000	100	1500
100	10	0.012	0.025	15	0.45	1000	320	1500
10	1	0.03	0.07	20	0.6	1000	1000	1500
1	0.1	0.2	0.5	60	3	500	2200	1500
0.1	0.01	2	5	400	60	160	4000	1500

Table 1-1 Ratings Per Step for Each Decade

TOTAL RESISTANCE AND MINIMUM STEP RESISTANCE AVAILABLE: Shown in Table 1-2.

MODEL	TOTAL RESISTANCE	OHMS PER STEP
DB 42	111.1Ω	0.01Ω
	1,111 Ω	0.1 Ω
	11,110 Ω	1 Ω
	111,100 Ω	10 Ω
	1,111,000 Ω	100 Ω
	11,110,000 Ω	1 k
DB 52	1,111.1Ω	0.01Ω
	11,111 Ω	0.1 Ω
	111,110 Ω	1 Ω
	1,111,100 Ω	10 Ω
	11,111,000 Ω	100 Ω
DB 62	11,111.1Ω	0.01Ω
	111,111 Ω	0.1 Ω
	1,111,110 Ω	1 Ω
	11,111,100 Ω	10 Ω

Table 1-2 Total Resistance and Minimum Step Resistance

II OPERATION

2.1 Operating Instructions

Three binding posts are provided for connections on the panel of each Dekabox. The GRD binding post is connected to the metal case which forms a shield for the unit.

The resistance of the unit corresponds to the setting of the in-line dials. The resistance per step of each decade switch is marked above the dial.

Note that switch positions correspond to clock number positions of the bar knobs: 1 is at one o'clock, 2 at two o'clock, and TEN at ten o'clock. This feature allows an operator to set the resistance by feel without looking at the unit.

2.2 Theory of Operation

The circuit consists of resistors switched in a series circuit. Figure 2-1 illustrates schematically the circuit of the Model DB 62. Models DB 42 and 52 are identical except for the number of decades.

Resistance values are related to the total resistance of the unit; these values are listed in Table 2-1.

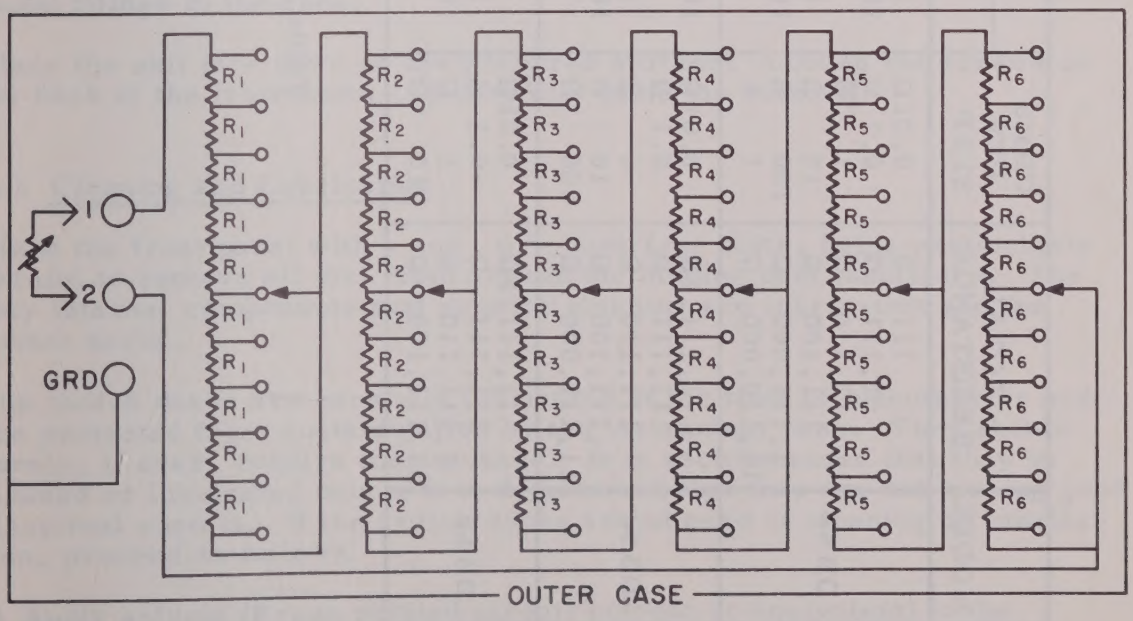

Figure 2-1 Dekabox Schematic Diagram

MODEL	TOTAL RESISTANCE	OHMS PER STEP	RESISTOR VALUES					
			R_1	R_2	R_3	R_4	R_5	R_6
DB 42	111.1Ω	0.01Ω	10Ω	1Ω	0.1Ω	0.01Ω		
	1,111 Ω	0.1 Ω	100Ω	10Ω	1 Ω	0.1 Ω		
	11,110 Ω	1 Ω	1k	100Ω	10 Ω	1 Ω		
	111,100 Ω	10 Ω	10k	1k	100 Ω	10 Ω		
	1,111,000 Ω	100 Ω	100k	10k	1 k	100 Ω		
	11,110,000 Ω	1 k	1 MEG	100k	10 k	1 k		
DB 52	1,111.1Ω	0.01Ω	100Ω	10Ω	1 Ω	0.1 Ω	0.01Ω	
	11,111 Ω	0.1 Ω	1k	100Ω	10 Ω	1 Ω	0.1 Ω	
	111,110 Ω	1 Ω	10k	1k	100 Ω	10 Ω	1 Ω	
	1,111,100 Ω	10 Ω	100k	10k	1 k	100 Ω	10 Ω	
	11,111,000 Ω	100 Ω	1 MEG	100k	10 k	1 k	100 Ω	
DB 62	11,111.1Ω	0.01Ω	1k	100Ω	10 Ω	1 Ω	0.1 Ω	0.01Ω
	111,111 Ω	0.1 Ω	10k	1k	100 Ω	10 Ω	1 Ω	0.1 Ω
	1,111,110 Ω	1 Ω	100k	10k	1 k	100 Ω	10 Ω	1 Ω
	11,111,100 Ω	10 Ω	1 MEG	100k	10 k	1 k	100 Ω	10 Ω

Table 2-1 Resistance Values

III PREVENTIVE MAINTENANCE

The following procedures should be performed periodically (approximately once a year) to insure maximum accuracy and reliability from the Dekabox in-line decade resistors.

If the need for major repairs is apparent, it is recommended that the unit be sent to the factory for service. The service department will be glad to furnish the necessary information for repairs as well as any replacement parts. However, unauthorized repairs will invalidate the instrument warranty. If the instrument is more than one year old when returned to the factory, a reasonable charge may be expected for replacement of parts or complete reconditioning.

3.1 Visual Inspection

Inspect the unit for dial orientation and damage to binding posts and binding post caps. Also check for dirt around the binding post insulators. Then remove the case as described in Paragraph 3.2 and inspect the unit for possible internal defects. These defects include such things as loose or broken connections, damaged or dirty switch contacts, and heat damaged resistors.

3.2 Removing the Case

Prepare a soft, clean place to set the instrument. Be sure that no projections or pointed objects will be underneath the panel. See that there are no metal filings in the area.

Place the unit face down on the prepared surface. Loosen the screws on the back of the instrument and carefully slide the case off.

3.3 Cleaning and Lubrication

Clean the front panel with a soft, dry, lint-free cloth, being particularly careful to remove all dirt from around the binding post insulators. The only internal components that require cleaning and lubrication are the switch decks.

The switch decks are carefully lubricated at the time of manufacture and are protected from contamination by the instrument case. They should rarely, if ever, require maintenance. It is recommended that they be cleaned or lubricated only if it is determined that they are not making good electrical contact. If the switch decks are in need of cleaning or lubrication, proceed as follows:

a) Apply solvent (Freon printed circuit solvent or equivalent) to the contact surfaces with a small brush or pipe cleaner.

b) Wipe surfaces with clean, dry brush or dry with low pressure air.

c) Apply a thin coating of lubricant (Oak #2008 or equivalent) to the contact surfaces with a hypodermic needle.

d) Apply two drops of the same oil to each of the switch bearings and detent mechanisms.

e) Remove excess oil with a clean, dry cloth and remove all traces of lint with a soft brush.

3.4 Replacing the Case

Be sure that the interior of the case is completely clear of all foreign material.

Slip the case over the unit being careful not to touch any resistors with the cover. Replace the screws.

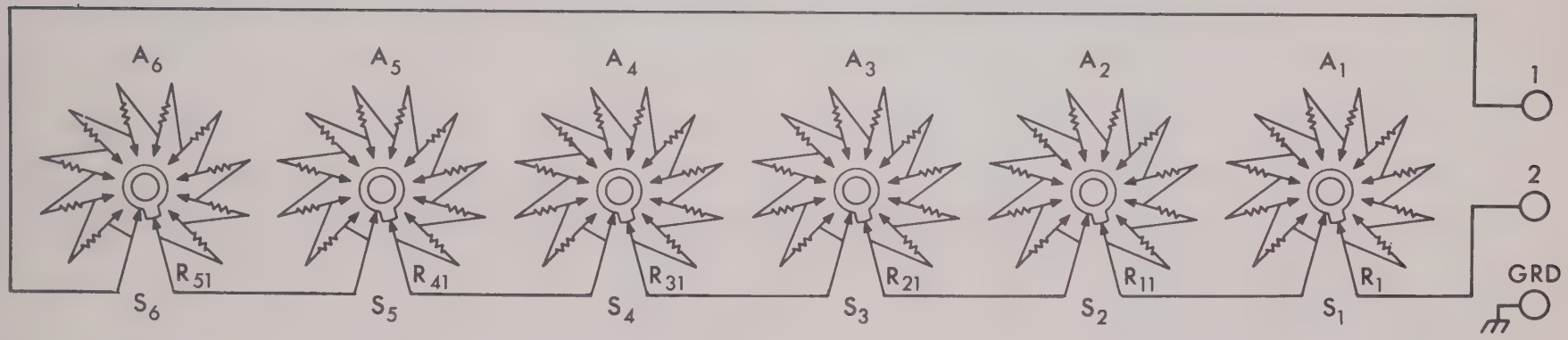

Figure 3-1 Wiring Diagram (DB 62 shown, DB 52 and DB 42 are identical except for A_5 and A_6)

IV PARTS LIST

The following tables list the replacement parts for the several types of Dekabox in-line decade resistors. Resistor switch assemblies vary in the value per step of the resistance. Table 4-1 lists the step resistance and part number of the assemblies in each type of Dekabox; the Dekaboxes are listed by model and total resistance, and the assemblies are listed by reference designation.

Table 4-2 lists replacement parts alphabetically by name of part. All parts listed herein are manufactured by Electro Scientific Industries, and may be ordered from the factory. When ordering parts, include the following information:

Model, serial number, and total resistance of the instrument

Electro Scientific Industries part number

Description of part

Manufacturer's Federal Stock Code (FSC)

11837	Electro Scientific Industries, Inc. Portland, Oregon

Table 4-1 Resistor Switch Assemblies

MODEL	TOTAL RESISTANCE	ASSEMBLY NO.					
		A_1	A_2	A_3	A_4	A_5	A_6
DB 42	111.1	10Ω 7548	1Ω 7549	0.1Ω 7550C	0.01Ω 7591B		
	1,111	100Ω 7547	10Ω 7548	1Ω 7549	0.1Ω 7550C		
	11,110	1k 7546	100Ω 7547	10Ω 7548	1Ω 7549		
	111,100	10k 7545	1k 7546	100Ω 7547	10Ω 7548		
	1,111,000	100k 7544	10k 7545	1k 7546	100Ω 7547		
	11,110,000	1 MEG 7557	100k 7544	10k 7545	1k 7546		
DB 52	1,111.1	100Ω 7547	10Ω 7548	1Ω 7549	0.1Ω 7550C	0.01Ω 7591B	
	11,111	1k 7546	100Ω 7547	10Ω 7548	1Ω 7549	0.1Ω 7550C	
	111,110	10k 7545	1k 7546	100Ω 7547	10Ω 7548	1Ω 7549	
	1,111,100	100k 7544	10k 7545	1k 7546	100Ω 7547	10Ω 7548	
	11,111,000	1MEG 7557	100k 7544	10k 7545	1k 7546	100Ω 7547	
DB 62	11,111.1	1k 7546	100Ω 7547	10Ω 7548	1Ω 7549	0.1Ω 7550C	0.01Ω 7591B
	111,111	10k 7545	1k 7546	100Ω 7547	10Ω 7548	1Ω 7549	0.1Ω 7550C
	1,111,110	100k 7544	10k 7545	1k 7546	100Ω 7547	10Ω 7548	1Ω 7549
	11,111,100	1MEG 7557	100k 7544	10k 7545	1k 7546	100Ω 7547	10Ω 7548

Table 4-2 Parts List

DESCRIPTION	ESI PART NO.	QUANTITY USED		
		DB 42	DB 52	DB 62
Assembly, Resistor switch, 1 Megohm per step	7557	*	*	*
Resistor, 1 Megohm	7558	10	10	10
Assembly, Resistor switch, 100k per step	7544	*	*	*
Resistor, 100k	7543	10	10	10
Assembly, Resistor switch, 10k per step	7545	*	*	*
Resistor, 10k	7542	10	10	10
Assembly, Resistor switch, 1k per step	7546	*	*	*
Resistor, 1k	7541	10	10	10
Assembly, Resistor switch, 100Ω per step	7547	*	*	*
Resistor, 100Ω	7540	10	10	10
Assembly, Resistor switch, 10Ω per step	7548	*	*	*
Resistor, 10Ω	7539	10	10	10
Assembly, Resistor switch, 1Ω per step	7549	*	*	*
Resistor, 1Ω	7538	10	10	10
Assembly, Resistor switch, 0.1Ω per step	7550C	*	*	*
Assembly, Resistor switch, 0.01Ω per step	7591B	*	*	*
Cap, Binding post, insulated	1170	2	2	2
Cap, Binding post, gold-plated	1172	1	1	1
Dial knob	7524	4	5	6

* One each where used; see Table 4-1.

NOTE: The 0.01Ω/step and 0.1Ω/step decades are not constructed with individual resistors. When repairing switch assemblies 7550C and 7591B the entire assembly should be replaced.

V CALIBRATION

5.1 Accuracy

The accuracy of an In-Line DEKABOX® decade resistor should be verified as frequently as stability records indicate and prior to use in special test circuits where ambient temperature and/or dissipated power exceeds normal laboratory conditions.

5.2 Recommended Test Equipment

1) ESI® Model 242A Resistance Measuring System
2) ESI Model SR 1010 Resistance Transfer Standard, 1Ω/step
3) ESI Model SR 1010 Resistance Transfer Standard, 10Ω/step
4) ESI Model SR 1010 Resistance Transfer Standard, 100Ω/step
5) ESI Model SR 1010 Resistance Transfer Standard, 1k/step
6) ESI Model SR 1010 Resistance Transfer Standard, 10k/step
7) ESI Model SR 1010 Resistance Transfer Standard, 100k/step
8) ESI Model PC 101 Parallel Compensating Network
9) ESI Model SPC 102 Series-Parallel Compensating Network
10) ESI Model SB 103 Shorting Bars (1 pair)
11) Thomas Pattern 1Ω Standard Resistor

The DEKABOX should be calibrated with a Resistance Bridge that has an accuracy of at least ±(0.01% + 0.0005 ohm) such as the Electro Scientific Industries Model 242A Resistance Measuring System which can be calibrated to an accuracy of ±0.001% with a set of ESI Model SR 1010 Resistance Transfer Standards and a Standard Resistor calibrated by the National Bureau of Standards.

5.3 Calibration Procedure

For maximum accuracy, the DEKABOX should be calibrated at 23°C with negligible power (e.g. 25 milliwatts) applied to its terminals. At any other ambient temperatures or input power greater than 100 milliwatts, temperature and power coefficients, unless accounted for, will adversely affect the calibration accuracy of the DEKABOX.

a) Perform the preventive maintenance as described in Section III before calibrating the DEKABOX.

b) Connect the DEKABOX to the Resistance Bridge.

c) Measure the resistance with all DEKABOX dials set to zero. This zero resistance will be subtracted from all of the other resistance readings.

d) Measure and record the resistance of the unit at the ten positions of each decade.

e) Subtract the zero resistance (found in Step c above) from each reading.

f) Record the ambient temperature and power applied to the terminals of the DEKABOX. Calculate and record the allowable changes in resistance value due to Temperature and Power Coefficients, whichever is

predominant. Sometimes both effects are appreciable, under given conditions.

g) Verify that the DEKABOX has the desired accuracy or meets the specifications listed in Paragraph 1.3 by subtracting the results in Step f from Step e.

5.4 Service and Repair

As part of its Customer Service Program, Electro Scientific Industries provides field-factory service by experienced technical specialists and field sales engineers. Repair and recalibration servicing facilities at our factory in Portland, Oregon permit a turn-around time of one to two weeks, maximum. Spare parts are available from our factory, only, with delivery from stock to ten days after receipt of order.

Prior to returning the item to our factory, please correspond with us, requesting shipping instructions and stating the problem to be solved. Model Number, Serial Number and approximate date of purchase is helpful information.

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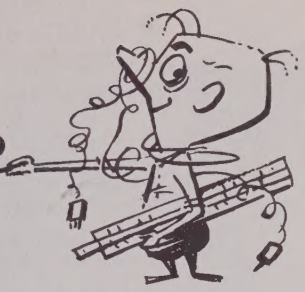

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